XI. *Aſtronomical Obſervations made at* Chiſlehurſt *in* Kent, *by the Reverend* Francis Wollaſton, *F. R. S.*

Received November 12, 1772.

Read Dec. 17, 1772.

I the laſt year did myſelf the honour to deliver to this Society, an account of the going of an aſtronomical clock with a wooden pendulum, for the year preceding; together with ſuch obſervations as I had made in this place; the latitude of which is 51° 24′ 33″ North, and its longitude 4′ 39″ = 18″,6 in time, Eaſt of the Royal Obſervatory at Greenwich. As that account ſeemed not wholly unacceptable, I have now continued it down to the preſent time: omitting however the ſeries of tranſits; which I gave in the former paper, merely to ſhew the exactneſs with which they might be taken with a very ſmall inſtrument, beyond what I had expected to find.

The rate of the clock deduced from the obſervations of this laſt year, will not be found ſo uniform as the foregoing. To what cauſe to aſcribe it, I am not certain. I think not to heat: perhaps to the great drought of the ſummer. However, its acceleration or retardation was not deſultory, but ſuf-

ficient

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ficient to be depended upon for any intermediate time. The clock was cleaned in November; and when ſet up again, loſt, between the 18th and 28th, at the rate of 7″,8 per day. The regulator was then altered, and clock ſet, and from that time never meddled with.

My obſervatory (if it deſerves that name) is a room up two pair of ſtairs, in a ſquare compact brick houſe, pretty much expoſed indeed to wind, from our high ſituation. The face of the clock turns due Eaſt. I have ſet down the *throwing-out* of the pendulum, as judged by the eye, on a ſcale behind it divided only to every 10 minutes; and therefore ſome of the variations may only be errors in judgment. How far a clock ſo ſituated may be affected by any motion of the houſe in windy weather, deſerves conſideration. I do not however perceive that it *is*, either in the *rate* or *throwing-out*.

1771.		Clock + too faſt — too ſlow for mean ſol. time.			Gain + or Loſs —	Num-ber of days.	Rate per day.	Throwing out on the	
								South ſide.	North ſide.
			′	″	″		″	° ′	° ′
Nov.	29	Clock —		0,6					
Dec.	16	—		17,9	— 17,3	17	— 1,02	1 42	1 45
	30	—		30,0	— 12,1	14	— 0,86	1 43	1 46
1772.									
Jan.	13	—		38,0	— 8,0	14	— 0,57	1 43	1 45
Feb.	4	—		44,9	— 6,9	22	— 0,31	1 43	1 46
	15	—		54,0	— 9,5	11	— 0,86	1 44	1 46
Mar.	3	—	1	2,9	— 8,9	17	— 0,52	1 42	1 44
April	4	—	1	5,7	— 2,8	32	— 0,09	1 42	1 44
	13	—	1	3,7	+ 2,0	9	+ 0,22	1 42	1 44
May	2	—		15,4	+ 48,3	19	+ 2,54	1 38	1 40
	13	+		27,4	+ 42,8	11	+ 3,89	1 43	1 45
	23	+	1	11,2	+ 43,8	10	+ 4,38	1 42	1 44
June	1	+	1	53,0	+ 41,8	9	+ 4,66	1 42	1 44
	15	+	2	54,1	+ 61,1	14	+ 5,08	1 43	1 45
July	3	+	4	48,9	+ 54,8	18	+ 6,38	1 43	1 45
	10	+	5	39,4	+ 50,5	7	+ 7,21	1 43	1 45
	21	+	7	0,5	+ 81,1	11	+ 7,37	1 43	1 45
	31	+	8	18,8	+ 78,3	10	+ 7,83	1 43	1 45
Aug.	8	+	9	16,9	+ 58,1	8	+ 7,26	1 48	1 50
	17	+	10	16,9	+ 60,0	9	+ 6,44	1 47	1 49
	28	+	11	29,8	+ 72,9	11	+ 6 63	1 47	1 49
Sept.	7	+	12	22,6	+ 52,8	10	+ 5,28	1 44	1 47
	15	+	12	53,9	+ 31,3	8	+ 3,91	1 46	1 48
	21	+	13	15,9	+ 22,0	6	+ 3,33		
Oct.	1	+	13	53,0	+ 37,1	10	+ 3,71	1 48	1 50
	10	+	14	20,6	+ 27,6	9	+ 3,06		
	19	+	14	40,6	+ 20,0	9	+ 2,22		
Nov.	2	+	15	13,0	+ 32,4	14	+ 2,31	1 44	1 48

I have this year kept a regiſter of the Thermometer and Barometer; the higheſt and loweſt ſtate of which, as I obſerved them in each month, I will here ſubjoin. I do not find that they have any reference to the rate of the clock; but they may ſerve for compariſon with other places. The Thermometer A was made by Mr. Nairne; and hangs without doors, near a window, up one pair of ſtairs, on the North ſide of my houſe; with a ſkreen to keep off the morning ſun in ſummer, but no building near it. The three firſt columns ſhew its ſtate at eight o'clock in the morning, two in the afternoon, and eleven at night. The fourth column gives the Thermometer B, in the obſervatory, near the face of the clock, at nine in the morning. The fifth ſhews the Barometer; which being portable, I cannot be certain that its ſcale is exactly placed; though I believe it is right. It is kept in a room on the ground floor.

1771.		Thermometer A.			B.	Barometer.
		H. 8. Mat.	H. 2. P. M.	H. 11. P. M.	H. 9. Mat.	
Dec.	Higheſt	52	50	53	52	30,05
	Loweſt	34	35	33	36	28,58
1772.						
Jan.	Higheſt	49	52	49	50	30,09
	Loweſt	22	30	21	29	28,63
Feb.	Higheſt	50	47	48	50	29 92
	Loweſt	25	32	24	32	28,79
Mar.	Higheſt	51	56	46	50	29,78
	Loweſt	27,5	31	27	30	28,79
April	Higheſt	51	59	50	52	30,04
	Loweſt	31	38	31	36	29,19
May	Higheſt	63	70	53	58	30,20
	Loweſt	42	47	33	44	29,35
June	Higheſt	73	82	68	73	30,12
	Loweſt	53	57	49	56	29 50
July	Higheſt	70	76,5	63	68	30,10
	Loweſt	55	61	49,5	58	29,16
Aug.	Higheſt	73	75	67	70	30,08
	Loweſt	52	62	50	60	29,25
Sept.	Higheſt	66	72	66,5	70	29,96
	Loweſt	48	58	46	45	28,82
Oct.	Higheſt	60	66	59	62	30,11
	Loweſt	44	52	43	51	28,88

Eclipſe of the Sun, ☉ October 25, 1772.

App. time.			
h	′	″	
20	31	12	The firſt impreſſion that I perceived. But I had looked for it on the Weſtern inſtead of the Eaſtern edge, owing to a miſtake in the Almanac; ſo that the Eclipſe was now about its greateſt obſcuration. A remarkable protuberance on that part of the Moon's limb.
20	36	34	End of the Eclipſe. Obſerved with a 3½ feet Achromatic Teleſcope, magnifying 150 times.

Occul-

Occultations of Stars by the Moon. Obſerved with the ſame teleſcope, magnifying 150 times.

1772.		Apparent time.				
			h	′	″	
♄ Feb. 15.	☽ λ ♊		9	24	8	Im. good.
			10	21	16	Em. certain to 2″.
☉ April 12.	☽ ω ♌		11	35	17	Im. The ✱ certainly began to loſe of its light 2″ before it diſappeared.
			12	1	35	Em.
♀ May 8.	☽ ✱		8	16	6	Im. Seen accidentally, as I was looking at ☽ with the magn. 100. The ✱ was near ζ ♋, but leſs N. dec.
						Em. cloudy.
♄ May 9	☽ κ ♋	.	.	.	.	Not eclipſed.
☿ 15.	☽ α ♎	1^{ma}.	11	56	50	Im. good. Night clear, and no air.
			13	0	23	Em. doubtful to 5″ or more.
		2^{da}.	12	2	19	Im. good.
			13	8	57	Em. good.
☽ Aug. 17.	☽ ζ ♓	1^{ma}.	10	57	25	Im. Night clear and ſtill; but ſuch undulation on ☽'s limb, that the imm. were doubtful.
			11	52	5	Em. good.
		2^{da}.	10	58	12	Im. very doubtful.
			11	52	59	Em. very good.
☉ Sept. 6.	☽ ρ ♐	1^{ma}.	8	41	41	Im. good.
						Em. Rain.
☽ 7.	☽ β ♑		13	9	21	Im. Hazy.
						Em. ☽ ſet.
♃ Oct. 8.	☽ ✱		9	7	46	Im. near Schikardus.
						Em. not ſeen.

Eclipſes of Jupiter's ſatellites. Obſerved with the ſame teleſcope, magnifying 100 times.

1772.			App. time.		
		h	′	″	
♄ July	11.	11	22	34	Firſt ſat. im. Good.
♄	27.	9	38	2	Firſt ſat. im. Vapours.
☿	29.	10	29	59	Second ſat. im. Cloudy and doubtful.
☽ Aug.	3.	11	32	48	Firſt ſat. im. Good.
♄	22.	9	38	35	Third ſat. em. Hazy.
☉	23.	10	35	19	Second ſat. em. Doubtful. Flying clouds.
♀	28.	8	28	14	Firſt ſat. em. Very doubtful.
☉ Sept.	27.	10	53	35	Firſt ſat. em. Doubtful.
☉ Oct.	4.	9	57	14	Third ſat. em. Good.
		12	50	41	Firſt ſat. em. Good.
♂	13.	9	17	13,5	Firſt ſat. em. Good.
♂	20.	11	14	32	Firſt ſat. em. Doubtful.

Occultations of Jupiter's ſatellites, and tranſits over his diſc, and conjunctions of the ſatellites, and appearances of his belts. Obſerved with the ſame teleſcope, magnifying 150 times.

1772.			App. time.		
		h	′	″	
♀ Aug.	7.	10	44	40	Second ſat. on the limb of ♃, in its egreſs from his diſc.
♂	11.	10	55	50	Firſt ſat. in contact with ♃'s limb.
		11	1	40	——— Total ingreſs on the diſc. The ſhadow precedes the ſat. but very little.
☿	12.	9	30	0	Appearance of ♃'s belts, as in Tab. III. Fig. I.
		10	45	0	Southern belt compleated.
♃	13.	10	15	0	Appearance of ♃'s belts, as in Fig. II.
♀	21.	9	13	8	Conjunction of firſt and ſecond ſat.
♄	29.	9	2	0	Third ſat. ſeemingly in contact with the limb.
		9	13	0	——— Occult.
☉	30	9	45	0	Second ſat. partly covered by the limb.
		9	48	40	——— Occult.

1772.		App. time			
		h	′	″	
☽ Sept.	7.	9	38	0	Appearance of ♃, with the ſhadow of the fourth ſat. central. The ſat. itſelf not viſible. Fig. III.
		11	10	0	The Southern belt equally advanced with the ſhadow.
♄	12.	8	39	20	Appearance of ♃, and ſhadow of the firſt ſat. central, Fig. IV. The ſhadow much ſmaller than that of the fourth.
		9	24	30	Southern belt advanced half way.
		9	29	0	Sat. now off the diſc, and ſhadow ſtill on; about equidiſtant from the limb.
		9	40	46	Shadow going off, in contact with the limb.
♂	15.	7	27	0	Appearance of ♃, as in Fig. V.
		8	22	20	Southern belt compleat, and dark ſpot (*a*) in the large belt, central.
		8	27	20	Second ſat. on the limb.
		8	30	20	——— Total ingreſs on the diſc.
		10	41	0	Shadow advanced about $\frac{1}{3}$ on the diſc: not very viſible: preceded by another dark round ſpot, ſmaller; I know not what. Fig. VI.
☿	16.	8	36	0	Shadow of the third ſat. about its own diameter from ♃'s limb. Well defined.
		9	19	0	Third ſat. quite off the diſc. The ſhadow was then advanced about $\frac{1}{3}$.
		9	33	0	Southern belt reduced to about $\frac{1}{3}$. The ſhadow advanced about $\frac{2}{5}$. Fig. VII.
		9	49	0	Shadow central.
		11	2	30	Shadow advanced about $\frac{4}{5}$. Southern belt then ſcarce viſible on the Eaſt ſide.
		11	35	0	Shadow either gone off, or not viſible on the limb. Southern belt now come on $\frac{1}{4}$ or more. Vide Fig. VIII.
♄	19.	8	43	30	Firſt ſat. ſeemingly in contact with ♃'s limb.
		8	52	0	——— Total ingreſs.
		9	7	40	Conjunction of ſecond and third ſat.
		9	32	0	Shadow of firſt ſat. half entered.
		9	35	30	——— totally entered.
		10	58	0	——— advanced about $\frac{2}{3}$.
		1	1	0	Firſt ſat. on the limb.
		11	4	30	——— external contact. Vide Fig. IX. Shadow very ſmall, but well defined.

1772.	App. time.			
	h	′	″	
⊙ Sept. 27.	7	37	30	Firſt ſat. in contact.
	7	42	0	——— occult.
♃ Oct. 1.	8	9	26	Conjunction of third and fourth ſat.
	8	14	45	Second ſat. in contact.
	8	20	0 ::	——— occult.
⊙ 4	9	27	40	Firſt ſat. in contact.
	9	32	30	——— occult.
☽ 5.	8	29	45	Firſt ſat. in contact, juſt gone off the limb. The ſhadow at that time about ⅔.
♂ 20.	7	40	15	Firſt ſat. in contact.
	7	44	20	——— occult.

Theſe laſt obſervations are not to be depended upon, within ſeveral ſeconds; and yet, if purſued regularly, might have their uſe. I was led into making them from what M. Meſſier tranſmitted to this Society, in a former paper, Vol. LIX. N° LXIV. Indeed the hint he there gave, concerning the ſuperiority of achromatic teleſcopes above all others for theſe purpoſes, induced me to procure one from Mr. Dollond, of his laſt conſtruction, with a triple object-glaſs; which, I believe, is excellent in its kind: at leaſt, it has fully anſwered the higheſt expectation I had formed of them.

The drawings ſhew how Jupiter appeared to me at different times. The broad belt acroſs the middle, I cannot tell what to make of; ſometimes it appears as a combination of ſeveral ſmaller ones; but uſually clouded, or waved, in the middle, with its edges in general darkeſt; perhaps from their oppoſition to the contiguous parts, which are always much brighter than the reſt of the planet. There have been two places in that belt particularly dark (eſpecially that marked α, Fig. V.), which I have ſeen latterly, whenever that ſide of ♃ has been turned towards us; though I did not perceive them Auguſt 12, when I took Fig. I. The Northern belt, I believe, is continued uniformly round the planet; the Southern one reaches little above half way. They are both of them darker, I think, than the general complexion of the largeſt. There is beyond each of theſe, a light part, not equally bright with thoſe zones near the middle; and from thence a gradual ſhading off to the poles themſelves; particularly to the North. The drawings are, as the objects appear in an aſtronomical teleſcope, and therefore inverted.

Chiſlehurſt,
November 10, 1772.

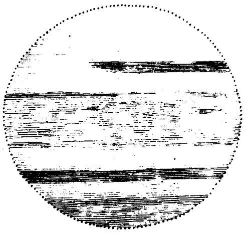
Francis Wollaſton.

THE Aſtronomer Royal, who was preſent at the reading of this paper, expreſſed a wiſh that a particular account of the mechaniſm of the clock itſelf, might accompany the regiſter of its going; as no conſideration ought to be omitted which might ſerve to elucidate theſe matters.

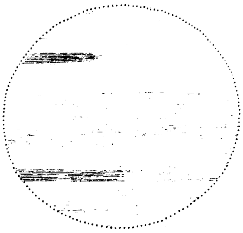
My clock is in general of the plain kind, moving in braſs pivot-holes, beating dead ſeconds, with the common ſteel paletts; but of good workmanſhip, as being made by Mr. Holmes. The rod of the pendulum is of deal, as mentioned in a former paper; to which the ball itſelf (weighing about fourteen pounds) is ſcrewed faſt, there being a ſmaller weight underneath for a regulator. Its ſuſpenſion is ſomewhat particular. The ſpring A is not hung in a ſlit as is uſual; but is faſtened to a tranſverſe piece B, on which it reſts upon the ſides of the cock. The ſhoulders of this piece confine the pendulum from any lateral motion, as much as it would be in a ſlit; but it is at full liberty to hang perpendicularly under its point of ſuſpenſion, without any ſtrain on either edge of the ſpring above the other. The crutch is alſo of an unuſual make. The bottom of the ſtem, inſtead of receiving the crutch-pin, is turned ſideways; at right angles to itſelf, but parallel to the back-plate. This piece D reaches about an inch, and at the end has a ſmooth ſteady joint E (known to the workmen by the name of a ſocket and ſtud), whoſe axis lies horizontal. From that joint there is a return F, of equal length with the former piece; at the end of which is the crutch-pin G, nearly coinciding with the end of the ſtem.

This return together with the crutch-pin, if the pendulum were removed, would fall down as repreſented by the dotted lines *f*, *g*. The deſign of this mechaniſm is that any friction at the crutch-pin, which in the common conſtruction is a ſmall ſliding up and down at every oſcillation, is hereby converted into a ſmaller circular motion in a ſmooth pivot-hole. Both theſe, I underſtand, are contrivances of the late Mr. Henry Hindley of York: and may be ſeen in the regulator at Mr. Holmes's in the Strand, which is conſtructed in the ſame manner. The cock is faſtened to the back-plate of the clock itſelf; but the clock-caſe is made ſtronger than uſual, and is firmly ſcrewed to the wall, independent on the floor.

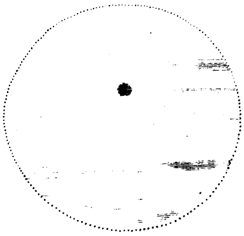
Fig. I.
Aug. 12. 1772
h. 9. 30. 0.



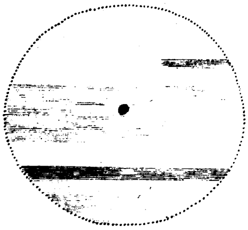
II.
Aug. 13
h. 10. 15. 0.



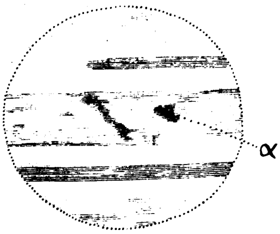
III.
Sept. 7. h. 9. 38. 0.
Shadow of 4th Sat.



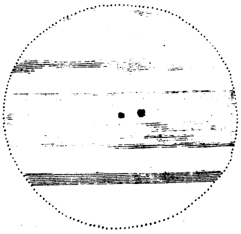
IV.
Sept. 12. h. 8. 39. 20
Shadow of 1st Sat.



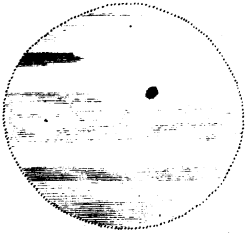
V.
Sept. 15. h. 7. 27. 0.



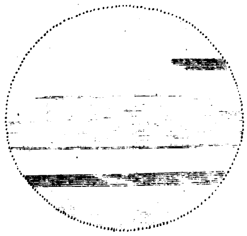
VI.
Sept. 15. h. 10. 41. 20
Shadow of 2d Sat.



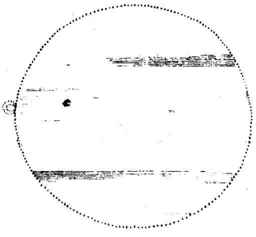
VII.
Sept. 16. h. 9. 33. 0
Shadow of 3d Sat.



VIII.
Sept. 16. h. 11. 35. 0.



IX.
Sept. 19. h. 11. 4. 30
1st Sat. & its Shadow.



Js. Basire Sculp.

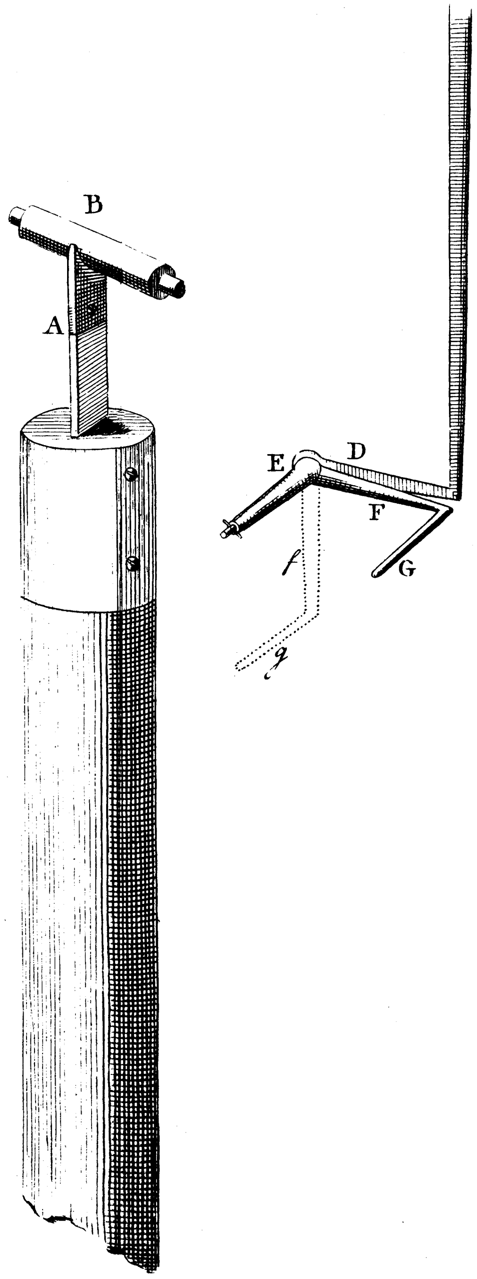
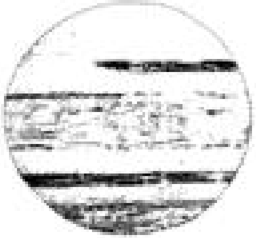
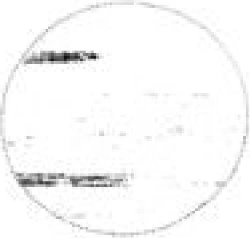

B
A
C
D
E
F
G
f
g

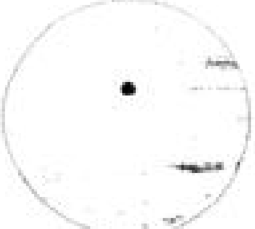
Fig. I.
Aug. 12. 1772
h. 9. 30. 0.



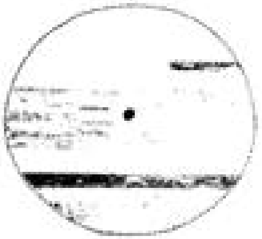
II.
Aug. 13
h. 10. 15. 0.



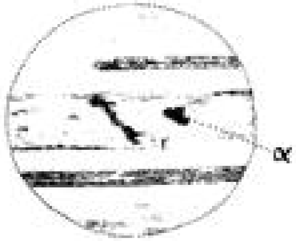
III.
Sept. 7. h. 9. 38. 0.
Shadow of 4th Sat.



IV.
Sept. 12. h. 8. 39. 20
Shadow of 1st Sat.

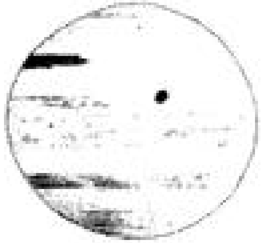


V.
Sept. 15. h. 7. 27. 0.

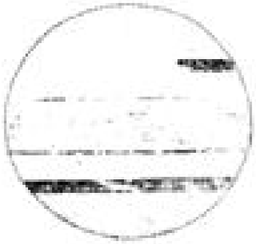


VI.
Sept. 15. h. 10. 41. 20
Shadow of 2. Sat.

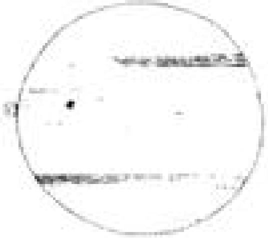
VII.
Sept. 16. h. 9. 33. 0
Shadow of 3d Sat.

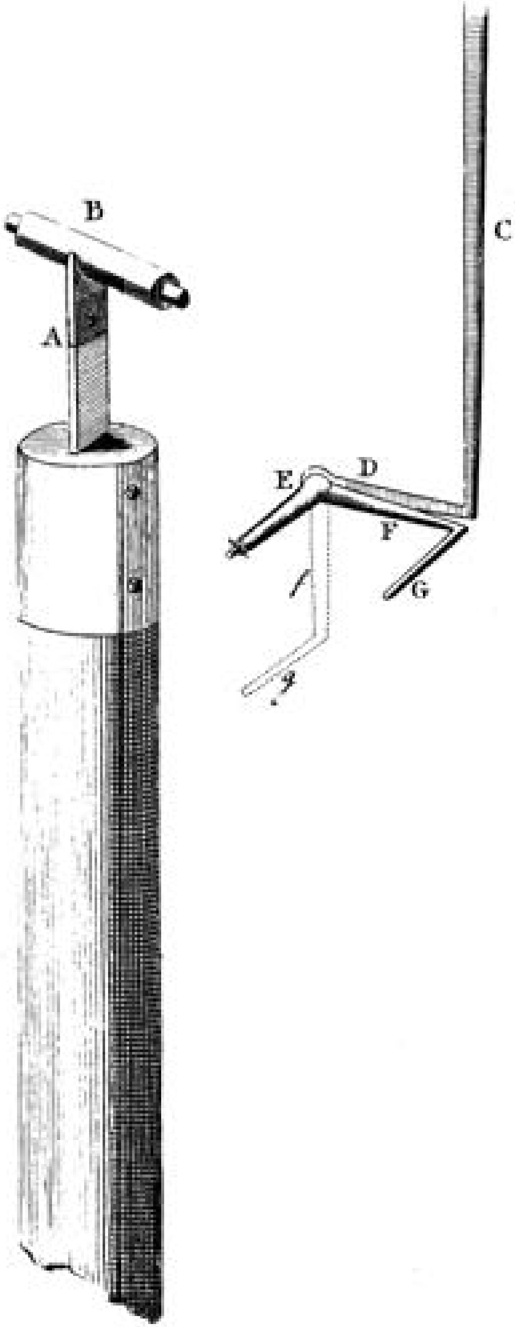


VIII.
Sept. 16. h. 11. 35. 0.



IX.
Sept. 19. h. 11. 4. 30
1st Sat. & its Shadow.





J. Basire sculp.